

# Institutional Report

| STANDARDS  | PROPOSED CHANGES TO RULES  | COMMENTS |
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| Draft 2014   |  |          |
| <b><u>10.58.522 SCIENCE</u></b>  |  |          |
| (1) The science program ensures that successful candidates follow the subject major and/or minor program of study or the broad field major program of study. Subject major and/or minor teaching endorsement programs are limited to biology, earth science, chemistry, and physics. The broad field major includes a concentration in one of the endorsable disciplines, coupled with balanced study in three other endorsable science disciplines. Science disciplines selected adhere to a scope and sequence which ensures a thorough grounding in the basic concepts, skills, and dispositions associated with Montana and national K-12 content standards. | (1) The science program ensures that successful candidates follow the subject major and/or minor program of study or the broad field major program of study. Subject major and/or minor teaching endorsement programs are limited to biology, earth science, chemistry, and physics. The broad field major includes a concentration in one of the endorsable disciplines, coupled with balanced study in three other endorsable science disciplines. Science disciplines selected adhere to a scope and sequence which ensures a thorough grounding in the basic concepts, skills, and dispositions associated with Montana and national K-12 content standards. |          |
| (2) The science endorsement requires that successful candidates:   | (2) The science endorsement requires that successful candidates:   |          |
| (a) demonstrate a thorough understanding of inquiry-based learning across the sciences. This preparation includes:<br>(i) both breadth and depth of knowledge in science, including recent significant changes in the field, as reflected by national standards; the science framework and their impact on the content knowledge necessary for teaching P-12 students;   | <del>(a) demonstrate a thorough understanding of inquiry-based learning across the sciences the nature of science and essential science and engineering practices. This preparation includes:</del><br><br><del>(i) both breadth and depth of knowledge in science,</del> including recent significant changes in the field, as reflected by <del>national standards</del> ; the science framework and their impact on the content knowledge necessary for teaching P-12 students;   |          |



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| (ii) competency in basic mathematics, statistics, and current and emerging technological applications to science teaching;                               | (ii) competency in basic mathematics, statistics, and current and emerging technological applications to science teaching;   |          |
| (iii) preparation and experience in environmental science, including Montana American Indian traditional relationships to the environment; and           | (iii) preparation and experience in environmental science, including Montana American Indian traditional relationships to the environment; and   |          |
| (iv) methods to engage in inquiry in a variety of ways;  | (iv) methods to engage in <u>active inquiry lessons</u> where <u>students ask questions, develop and use models, plan and carry out investigations, analyze and interpret data using applicable science-specific technology, mathematics and computational thinking, in order to construct explanations and solutions and communicate concepts by engaging in argument from evidence.</u> <del>in a variety of ways;</del> |          |
| (b) demonstrate knowledge and skills in the methods of guided and facilitated learning in order to interpret and communicate science research to others; | (b) demonstrate knowledge and skills <del>in the methods of guided and facilitated learning in order to interpret and communicate science research to others</del> <u>in obtaining, evaluating, and communicating information using multiple</u>   |          |



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|  | <u>sources in order to communicate claims, methods and designs to others;</u>  |          |
| (c) apply instructional strategies which model learning environments with extended time, appropriate space, and resources with equipment and technology found in the contemporary secondary classroom; | <p><del>(c) apply instructional strategies which model learning environments with extended time, appropriate space, and resources with equipment and technology found in the contemporary secondary classroom;</del></p> <p><u>Use a variety of strategies that demonstrate the candidates' knowledge and understanding of how to select the appropriate teaching and learning activities – including laboratory or field settings and applicable instruments and/or technology- to allow access so that all students learn. These strategies are inclusive and motivating for all students.</u></p> |          |
| (d) demonstrate understanding and experience of how to develop and maintain the highest levels of safety in classrooms, stockrooms, laboratories, and other areas related to instruction in science.   | <p><del>(d) demonstrate understanding and experience of how to develop and maintain the highest levels of safety in classrooms, stockrooms, laboratories, and other areas related to instruction in science;</del></p> <p><u>safety procedures, and the treatment of living organisms needed in the classroom appropriate to the area of licensure.</u></p>  |          |
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| (e) demonstrate knowledge of formative and summative assessment techniques which model a variety of authentic and equitable assessment strategies that ensure the continuous intellectual, social, and personal development of the learner in all aspects of science. | (e) <del>demonstrate knowledge of</del> <u>plan fair and equitable diagnostic, formative, and summative assessment techniques strategies that confront and address naïve mental models and continuously evaluate ideas that students hold and the understandings students have formulated to determine if learning goals are met and are at a level beyond memorization. which model a variety of authentic and equitable assessment strategies that ensure the continuous intellectual, social, and personal development of the learner in all aspects of science.</u> |          |
| (f) apply and evaluate models of interdisciplinary approaches to provide experiences in understanding science;  | (f) <del>apply and evaluate models of interdisciplinary approaches to provide experiences in understanding science;</del> <u>interrelate and interpret important concepts, ideas, and applications in their fields of licensure and supporting disciplines;</u>   |          |
| (g) articulate a well-defined rationale for instructional goals, materials, and actions in relation to state and national education standards and student achievement.  | (g) <del>articulate a well-defined rationale for instructional goals, materials, and actions in relation to</del> <u>show an understanding of state and national education curriculum standards and</u>   |          |



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|  | <u>their impact on the content knowledge necessary for teaching P-12 students. and student achievement.</u>  |          |
| <p>(3) The candidate for an endorsement in earth science has the following knowledge and skills, including:</p> <p>(a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation, change, constancy, measurement, evolution and equilibrium, form and function;</p> | <p>(3) <del>The candidate for an endorsement in earth science</del> <u>has cross- cutting concepts and disciplinary core ideas for an endorsement</u> <del>includes: the following knowledge and skills, including:</del></p> <p>(a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation, change, constancy, measurement, evolution and equilibrium, form and function;</p>   |          |
| <p>(b) exploration and inquiry learning as tools in investigating all aspects of the natural environment, and knows how to apply and teach these methods when instructing students;</p>  | <p>(b) <del>exploration and inquiry learning as tools in investigating all aspects of the natural environment, and knows how to apply and teach these methods when instructing students;</del></p> <p><u>developing lesson plans using a variety of approaches where students collect and interpret data using applicable science-specific technology in order to develop science and engineering practices, understanding cross-cutting concepts and processes, relationships and natural patterns from empirical experiences. These plans provide for equitable achievement of science literacy for all students</u></p> |          |



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|  | <u>and demonstrate knowledge and understanding of how all students learn science.</u>   |          |
| (c) systematic and quantitative study of the fundamental topics in earth science interrelated and illustrated with descriptive and historical perspectives, as well as the applications of earth science in society;   | (c) systematic and quantitative studies of the fundamental topics in earth science interrelated and illustrated with descriptive and historical perspectives, as well as the applications of earth science in society;  |          |
| (d) conceptual understanding of astronomy, geology, paleontology, meteorology, and oceanography, and their relations with each other;  | (d) conceptual understanding of astronomy, geology, paleontology, meteorology, and oceanography, and their relations with each other;   |          |
| (e) conceptual understanding of biology, chemistry, or physics, emphasizing the interrelationships among the sciences and their relations to earth science;  | (e) conceptual understanding of biology, chemistry, or physics, emphasizing the interrelationships among the sciences and their relations to earth science;   |          |
| (f) conceptual understanding of mathematics, including a working knowledge of trigonometry and statistics;   | (f) conceptual understanding of mathematics, including a working knowledge of trigonometry and statistics;  |          |
| (g) conceptual understanding of ethical and human implications of such contemporary issues as the impact of technologies on earth systems;   | (g) conceptual understanding of ethical and human implications of such contemporary issues as the impact of technologies on earth systems;  |          |
| (h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, and facilities which support and enhance curricula and instruction in earth science and especially techniques and strategies for using the local | (h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, and facilities which support and enhance curricula and instruction in earth science and especially techniques and strategies for using the local environment as a teaching/learning laboratory; and |          |



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| environment as a teaching/learning laboratory;<br>and   |  |          |
| (i) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself and especially using questions to define problems and potential solutions.  | (i) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself and especially using questions to define problems and potential solutions.   |          |
| <p>(4) The candidate for an endorsement in biology demonstrates the following knowledge and skills, including:</p> <p>(a) understanding of the unifying concepts of biological systems: cellular organization, order, sensitivity, growth/development/reproduction, energy utilization, evolutionary adaptation, and homeostasis;</p> | <p>(4) The candidate for an endorsement in biology demonstrates the following <u>core competencies knowledge and skills</u>, including:</p> <p><del>(a) understanding of the unifying concepts of biological systems: cellular organization, order, sensitivity, growth/development/reproduction, energy utilization, evolutionary adaptation, and homeostasis;</del><br/> <u>(a) Life processes in living systems including organization of matter and energy.</u></p> <p><u>(b) Similarities and differences among animals, plants, fungi, microorganisms, and viruses.</u></p> <p><u>(c) Ecological systems including the interrelationships and dependencies of organisms with each other and their environments.</u></p> <p><u>(d) Population dynamics and the impact of population on its environment.</u></p> |          |



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| Draft 2014 | <p><u>(e) General concepts of genetics and heredity.</u></p> <p><u>(f) Organizations and functions of cells and multi-cellular systems.</u></p> <p><u>(g) Behavior of organisms and their relationships to social systems.</u></p> <p><u>(h) Regulation of biological systems including homeostatic mechanisms.</u></p> <p><u>(i) Fundamental processes of modeling and investigating in the biological sciences.</u></p> <p><u>(j) Applications of biology in environmental quality and in personal and community health.</u></p> <p><u>(k) Bioenergetics, including major biochemical pathways.</u></p> <p><u>(l) Molecular genetics and heredity and mechanisms of genetic modification.</u></p> <p><u>(m) Molecular basis for evolutionary theory and classification.</u></p> |          |



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| (b) exploration and inquiry learning as tools in investigating all aspects of the natural environment and knows experimental design and how to apply and teach these methods;                             | <del>(b) exploration and inquiry learning as tools in investigating all aspects of the natural environment and knows experimental design and how to apply and teach these methods;</del><br><u>(n) and understands the cross-cutting concepts and disciplinary core ideas for an endorsement in advanced competencies including:</u><br><br><u>(o) biochemical interactions of organisms and their environments.</u> |          |
| (c) conceptual understanding of living organisms, ethical laboratory and field studies promoting scientific inquiry, applications of biology in social and historical perspectives;                       | <del>(c)(p) conceptual understanding of living organisms, ethical laboratory and field studies promoting scientific inquiry, applications of biology in social and historical perspectives;</del><br><br><u>causes, characteristics, and avoidance of viral, bacterial, and parasitic diseases.</u>  |          |
| (d) course work in the diversity of life including zoology, botany, and microbiology, encompassing the sub disciplines and noting the interrelationships of physiology, genetics, ecology, and evolution; | <del>(d)(q) course work in the diversity of life including zoology, botany, and microbiology, encompassing the sub disciplines and noting the interrelationships of physiology, genetics, ecology, and evolution;</del><br><br><u>(r) molecular genetics.</u>  |          |
| (e) conceptual understanding of mathematics including a working knowledge of probability and statistics;  | <del>(e) (s) conceptual understanding of mathematics including a working knowledge of probability and statistics;</del>  |          |



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|  | <u>issues related to living systems such as genetic modification, uses of biotechnology, cloning, and pollution from farming.</u>  |          |
| (f) conceptual understanding of two out of three areas of physics, chemistry, or earth science emphasizing the interrelationships among the sciences;  | <p><del>(f) (t) conceptual understanding of two out of three areas of physics, chemistry, or earth science emphasizing the interrelationships among the sciences;</del></p> <p><u>historical development and perspectives in biology including contributions of significant figures and underrepresented groups, and the evolution of theories in biology.</u></p> |          |
| <del>(g) conceptual understanding of the relationships between biology and molecular genetics and the impacts of biotechnology upon humans and their environment including ethical and legal implications;</del> | <p><del>(g) (u) conceptual understanding of the relationships between biology and molecular genetics and the impacts of biotechnology upon humans and their environment including ethical and legal implications;</del></p> <p><u>how to design, conduct, and report research in biology.</u></p>  |          |
| (h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, facilities, and                              | <del>(h)(v) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, facilities, and specimens which support and enhance</del>  |          |



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| Draft 2014<br>specimens which support and enhance curricula and instruction in biology; and  | <del>curricula and instruction in biology; how to design, conduct, and report research in biology.-and</del><br><br><u>supporting competencies including:</u><br><u>(i) General chemistry, :</u><br><u>(ii) Biochemistry;</u><br><u>(iii) Basic chemistry laboratory techniques.</u>  |          |
| (i) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself, and especially using questions to define problems and <del>potential solutions.</del> | <del>(i) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself, and especially using questions to define problems and</del><br><u>(iv) Physics including light, sound, optics, electricity, energy &amp; order, and magnetism:</u><br><br><u>(v)Earth and space sciences including energy and geochemical cycles, climate, oceans, weather , natural resources, and changes in the Earth:</u><br><br><u>(vi) Mathematics including Probability &amp; Statistics</u> |          |
| (5) The candidate for an endorsement in chemistry demonstrates the following knowledge and skills, including:<br><br>(a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation,                 | (5) The candidate for an endorsement in chemistry demonstrates the following <del>knowledge and skills, including:</del> core competencies: <del>knowledge and skills, including:</del><br><br>a) Fundamental structures of atoms and molecules<br>b) Basic principles of ionic, covalent, and metallic bonding   |          |



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| <p>Draft 2014</p> <p>change constancy, measurement, evolution and equilibrium, form and function;</p> | <ul style="list-style-type: none"> <li>c) Periodicity of physical and chemical properties of elements</li> <li>d) Laws of conservation of matter and energy</li> <li>e) Fundamental of chemical kinetics, equilibrium and thermodynamics</li> <li>f) Kinetic molecular theory and gas laws</li> <li>g) Mole concept, stoichiometry, and laws of composition</li> <li>h) Solutions, colloids, and colligative properties</li> <li>i) Acids/base chemistry</li> <br/> <li>j) Fundamental oxidation-reduction chemistry</li> <li>k) Fundamental organic chemistry and biochemistry</li> <li>l) Nature of science: Fundamental processes in chemistry</li> <li>m) Applications of chemistry in personal and community</li> <li>n) health and environmental quality</li> <li>o) Fundamentals of nuclear chemistry</li> <li>p) Historical development and perspectives in chemistry</li> </ul> |          |



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|  | <p><u>and understands the cross-cutting concepts and disciplinary core ideas for an endorsement in advanced competencies including:</u></p> <ul style="list-style-type: none"> <li>q) principles of electrochemistry</li> <li>r) transition elements and coordination compounds</li> <li>s) molecular orbital theory, aromaticity, metallic and ionic structures, and correlation to properties of matter</li> <li>t) advanced concepts in chemical kinetics, equilibrium, gas laws, and thermodynamics</li> <li>u) Lewis structures and molecular geometry</li> <li>v) advanced concepts in acid/base chemistry, including buffers</li> <li>w) major biological compounds and reactions</li> <li>x) solvent system concepts</li> <li>y) chemical reactivity and molecular structure including electronic and steric effects</li> <li>z) organic chemistry including syntheses, reactions, mechanisms, and aromaticity</li> <li>aa) green chemistry and sustainability</li> <li>bb) how to design, conduct, and report research in chemistry</li> </ul> |          |
| (b) exploration and inquiry as tools in investigating all aspects of the natural | <p><del>(b) exploration and inquiry as tools in investigating all aspects of the natural environment and knows how to apply and teach these methods when instructing students;</del></p>  |          |



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| environment and knows how to apply and teach these methods when instructing students;   |  |          |
| (c) systemic and quantitative study of the fundamental topics of chemistry, interrelated and illustrated with descriptive and historical perspectives, as well as the applications of chemistry in society;   | <del>(c) systemic and quantitative study of the fundamental topics of chemistry, interrelated and illustrated with descriptive and historical perspectives, as well as the applications of chemistry in society;</del>   |          |
| (d) conceptual understanding of organic, inorganic, analytical, physical, and biochemistry, and their relationships with each other;  | <del>(d) conceptual understanding of organic, inorganic, analytical, physical, and biochemistry, and their relationships with each other;</del>  |          |
| (e) conceptual understanding of physics, biology, or earth science emphasizing the interrelationships among the sciences;   | <del>(e) conceptual understanding of physics, biology, or earth science emphasizing the interrelationships among the sciences;</del>   |          |
| (f) conceptual understanding of mathematics including a working knowledge of calculus;  | <del>(f) conceptual understanding of mathematics including a working knowledge of calculus;</del>  |          |
| (g) conceptual understanding of the interaction of chemistry and technology in contemporary health, ethical, legal, and human issues (e.g., the effects of synthetic molecules and food additives on life systems and the disposal of toxic chemical wastes);                     | <del>(g) conceptual understanding of the interaction of chemistry and technology in contemporary health, ethical, legal, and human issues (e.g., the effects of synthetic molecules and food additives on life systems and the disposal of toxic chemical wastes);</del>                     |          |
| (h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, facilities, and chemicals which support and enhance curricula and instruction in chemistry; and | <del>(h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, facilities, and chemicals which support and enhance curricula and instruction in chemistry; and</del> |          |



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| (i) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself and especially using questions to define problems and potential solutions.  | <del>(i) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself and especially using questions to define problems and potential solutions.</del>   |          |
| (6) The candidate for an endorsement in physics demonstrates the following knowledge and skills, including:<br>(a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation, change constancy, measurement, evolution and equilibrium, form and function; | <del>(6) The candidate for an endorsement in physics demonstrates the following knowledge and skills, including:<br/>(a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation, change constancy, measurement, evolution and equilibrium, form and function;</del> |          |
| (b) exploration and inquiry learning as tools in investigating all aspects of the natural environment, and knows how to apply and teach these methods when instructing students;  | <del>(b) exploration and inquiry learning as tools in investigating all aspects of the natural environment, and knows how to apply and teach these methods when instructing students;</del>   |          |
| (c) systematic and quantitative study of the fundamental topics in physics, interrelated and illustrated with descriptive and historical perspectives, as well as the applications of physics in society;   | <del>(c) systematic and quantitative study of the fundamental topics in physics, interrelated and illustrated with descriptive and historical perspectives, as well as the applications of physics in society;</del>  |          |
| (d) conceptual understanding of classical mechanics, electricity and magnetism, heat and thermodynamics, waves, optics, atomic and nuclear physics, radiation and radioactivity, relativity, quantum mechanics, and other fields of   | <del>(d) conceptual understanding of classical mechanics, electricity and magnetism, heat and thermodynamics, waves, optics, atomic and nuclear physics, radiation and radioactivity, relativity, quantum mechanics, and other fields of modern physics, and their relationships with each other;</del>   |          |



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| modern physics, and their relationships with each other;   |   |          |
| (e) conceptual understanding of biology, chemistry, or earth science emphasizing interrelationships among the sciences;  | <del>(e) conceptual understanding of biology, chemistry, or earth science emphasizing interrelationships among the sciences;</del>  |          |
| (f) conceptual understanding of mathematics, including an introduction to calculus;  | <del>(f) conceptual understanding of mathematics, including an introduction to calculus;</del>  |          |
| (g) conceptual understanding of interaction of physics and technology in contemporary health, ethical, legal, and human issues (e.g., power plant siting and waste disposal, long-range energy policies, and the effects of radiation on living systems);            | <del>(g) conceptual understanding of interaction of physics and technology in contemporary health, ethical, legal, and human issues (e.g., power plant siting and waste disposal, long-range energy policies, and the effects of radiation on living systems);</del>            |          |
| (h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, and facilities which support and enhance curricula and instruction in physics; and | <del>(h) designing, developing, and evaluating field, demonstration, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, and facilities which support and enhance curricula and instruction in physics; and</del> |          |
| (i) facilitating classroom discourse through questions, reflecting on, and critically analyzing ideas leading students toward a deeper understanding of the inquiry process itself, especially using questions to define problems and potential solutions.           | <del>(i)</del> -(cc) facilitating classroom discourse through questions, reflecting on, and critically analyzing ideas leading students toward a deeper understanding of the inquiry process itself, especially using questions to define problems and potential solutions.     |          |
| (7) The candidate for an endorsement in broad field science demonstrates the following knowledge and skills, including:  | <del>(7)</del> <u>(6)</u> The candidate for an endorsement in broad field science demonstrates the following <u>core competencies</u> knowledge and skills, including:  |          |



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| (a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation, change constancy, measurement, evolution and equilibrium, form and function; | (a) conceptual understanding in the unifying concepts and processes of systems order and organization, evidence models and explanation, change constancy, measurement, evolution and equilibrium, form and function;  |          |
| (b) exploration and inquiry learning as tools in investigating all aspects of the natural environment and knows how to apply and teach these methods when instructing students;                                      | (b) <del>exploration and inquiry learning as tools in investigating all aspects of the natural environment and knows how to apply and teach these methods when instructing students;</del><br><u>develop lesson plans using a variety of approaches where students collect and interpret data</u><br><u>using applicable science-specific technology in order to develop science and engineering practices, understand cross-cutting concepts and processes, relationships and natural patterns from empirical experiences. These plans provide for equitable achievement of science literacy for all</u> |          |



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|  | <u>students and demonstrate knowledge and understanding of how all students learn science.</u>   |          |
| (c) systematic and quantitative study of the fundamental topics in biology, chemistry, physics, and earth science including descriptive and historical perspectives, as well as the applications of these sciences in society;   | (c) <del>systematic and quantitative</del> <u>interdisciplinary</u> study of the fundamental topics in biology, chemistry, physics, and earth science including descriptive and historical perspectives, as well as the applications of these sciences in society;   |          |
| (d) study and experiences emphasizing interrelationships among all the sciences, as well as cross-cutting concepts of the sciences with other areas of study such as mathematics, technology, and engineering.   | (d) study and experiences emphasizing interrelationships among all the sciences, as well as cross-cutting concepts of the sciences with other areas of study such as mathematics, technology, and engineering.   |          |
| (e) conceptual understanding of mathematics, including a working knowledge of calculus and statistics;   | (e) conceptual understanding of mathematics, including a working knowledge of calculus and statistics;   |          |
| (f) conceptual understanding of the relationships among science, science technologies, and the study of environmental education;   | (f) conceptual understanding of the relationships among science, science technologies, and the study of environmental education;   |          |
| (g) designing, developing, and evaluating field experiences, demonstrations, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, facilities, and specimens which support and enhance curricula and instruction in all sciences | (g) designing, developing, and evaluating field experiences, demonstrations, and laboratory instructional activities, and in using special skills and techniques with equipment, technologies, facilities, and specimens which support and enhance curricula and instruction in all sciences including laboratory and field studies that promote |          |



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| including laboratory and field studies that promote the science and engineering practices, and the use of experimental methods;  | the science and engineering practices, and the use of experimental methods;  |          |
| (h) conceptual understanding of earth sciences including course work in astronomy, geology, paleontology, meteorology and oceanography, and their relationships with each other;   | (h) conceptual understanding of earth sciences including course work in astronomy, geology, paleontology, meteorology and oceanography, and their relationships with each other;   |          |
| (i) conceptual understanding of biology including course work in zoology, botany, physiology, genetics, ecology, microbiology, cell biology/biochemistry, and evolution, and their relationships with each other. This preparation must include study and experiences emphasizing living organisms;                              | (i) conceptual understanding of biology including course work in zoology, botany, physiology, genetics, ecology, microbiology, cell biology/biochemistry, and evolution, and their relationships with each other; <del>This preparation must include study and experiences emphasizing living organisms;</del>                   |          |
| (j) conceptual understanding of chemistry including course work in organic, inorganic, analytical, <del>physical</del> and biochemistry and their relationships with each other;   | (j) conceptual understanding of chemistry including course work in organic, inorganic, analytical, <del>physical</del> and biochemistry and their relationships with each other;   |          |
| (k) conceptual understanding of physics including course work in classical mechanics, electricity and magnetism, heat and thermodynamics, waves, optics, atomic and nuclear physics, radiation and radioactivity, relativity, quantum mechanics, and other fields of modern physics and their relationships with each other; and | (k) conceptual understanding of physics including course work in classical mechanics, electricity and magnetism, heat and thermodynamics, waves, optics, atomic and nuclear physics, radiation and radioactivity, relativity, quantum mechanics, and other fields of modern physics and their relationships with each other; and |          |
| (l) facilitating classroom discourse through questioning, reflecting on, and critically analyzing  | (l) facilitating classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading   |          |



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| ideas, leading students toward a deeper understanding of the inquiry process itself, and especially, using questions to define problems and potential solutions.   | students toward a deeper understanding of the inquiry process itself, and especially, using questions to define problems and potential solutions. |          |
| (History: 20-2-114, MCA; <u>IMP</u> , 20-1-501, 20-2-121, MCA; <u>NEW</u> , 1979 MAR p. 492, Eff. 5/25/79; <u>AMD</u> , 1984 MAR p. 831, Eff. 5/18/84; <u>AMD</u> , 1989 MAR p. 397, Eff. 3/31/89; <u>AMD</u> , 2000 MAR p. 2406, Eff. 9/8/00; <u>AMD</u> , 2007 MAR p. 190, Eff. 2/9/07.) |   |          |



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